

and typing in a new value, followed by pressing the Enter key on the user's keyboard. The user cannot change the parameter name or description.

[0076] To the left of the parameter name is a checkbox 46. If the user clicks this checkbox, a checkmark will appear. When the user clicks this checkbox, the user is telling the Transducer Design Advisor that the user wants this parameter to become a DOE input variable. These variables will be automatically appended to the set of standard DOE input variables.

[0077] When the user is satisfied with his/her changes to the parameters for a particular layer, the user clicks the "OK" button at the bottom of the window. If the user wishes to discard any changes to the parameter values, the user clicks the "Cancel" button at the bottom left.

[0078] As seen in FIG. 7, the next window in succession is named "RowTechnology". The "RowTechnology" window 50 is shown in FIG. 6 In accordance with the preferred embodiment of the Transducer Design Advisor, any one of four different multirow technologies can be selected by clicking on a respective radio button 52. The first is just a traditional single row of elements. The second is the active matrix array (AMA) multirow technology. The third and fourth types are the 1.5D and the 1.75D probes respectively. The terms "1.5D" and "1.75D" are handy shortcuts for naming two different kinds of multirow probe. A so-called "1.5D" probe is a probe having multiple rows that span the elevation dimension of the probe, where rows at symmetrical locations in elevation are electrically tied together element by element. Such a probe can have independent focusing for elements in each distinct row, but because the elements in rows that are symmetric in elevation are tied together, the beam cannot be electrically steered in the elevation direction. A so-called "1.75D" probe has the same row geometry, but the restriction that elements in rows that are symmetrical in elevation are tied together is removed. Such a probe could be electrically steered in elevation through modest angles, but not for large angles because the number of rows, and thus sampling in elevation, is crude compared to the

number of elements in the azimuth dimension, and large steering angles in elevation would produce unacceptable levels of grating lobe type artifacts in the image. All of the choices are graphically depicted on the right-hand side of the window.

[0079] As shown in FIG. 7, the Transducer Design Advisor has a multiplicity of other screens for selecting various probe geometric features and various imaging system parameters. For a multi-row probe, the user can simulate either a conventional lens or a multi-focus lens (block 54 in FIG. 7). In accordance with the preferred embodiment of the invention, the probe types which are supported in the simulator are linear (flat), convex (curved), and sector (flat). The type of probe the user chooses (block 56 in FIG. 7) will affect later questions which relate to the basic geometry of the probe.

[0080] When the user gets to the XducerDone page (58 in FIG. 7), the user has finished specifying the characteristics of the transducer being simulated, as least so far as the ultrasound simulator understands them. The remaining windows are used to tell the ultrasound simulator how to set up the conditions under which this transducer will be simulated. Window 58 has no input parameters, and is presented to the user as a kind of progress indicator. To proceed, the user clicks on the Next button.

[0081] The ultrasound beam simulator can simulate Bmode, Color Flow, or PE Doppler. The mode is selected in the MajorMode window 60. Actually, there is really no difference between the way the simulator works in Bmode and Color Flow, but there is an important difference in PE Doppler: namely, dynamic focusing is disabled in this mode. If the user wants to simulate a probe's performance in Color Flow, the user may very well want to change things like the excitation waveform, which will typically be a longer toneburst than the short pulses used in Bmode. However, the user actually specifies the excitation waveform in a different window (the XmitWaveforms window 62 in FIG. 7) and so when the user picks Color Flow mode in this window, the user is basically just setting a flag for documentation purposes. In

the XmitWaveforms window 62, the user specifies the excitation waveform to use during simulation. The user can specify a different waveform for each active focal zone. This XmitWaveforms window supports several methods for specifying the transmit waveform: the user can specify an impulse (positive one-half wave) at a particular frequency; the user can specify a toneburst of a specified number of cycles at a particular frequency; or the user can use an interactive mouse-based graphical editor to customize the transmit waveform for each zone.

[0082] For many multiplexed probes, the number of elements in the probe exceeds the number of channels in the system console. The probe multiplexer and system commutation hardware act to connect a subset of the probe elements to the available system channels to define a particular aperture, which is then often translated across the face of the probe by changing the mux state to connect a different subset of channels. The number of system channels defines the maximum transmit and receive apertures which can be used for any given mux state. In some situations, the number of system channels is the factor that limits aperture growth as the aperture expands with deeper ranges. In other situations, the aperture growth is limited by some other factor, such as element directivity or an aperture that is close to one end of the array. In any event, the ultrasound beam simulator needs to know the maximum number of system channels in order to assess the limitations on aperture growth. The Transducer Design Advisor (via the NumChannels window 64) will accept any positive number greater than or equal to 2.

[0083] For radiology, image features such as spatial resolution, contrast resolution, signal-to-noise ratio, and speckle appearance are the most important CTQs, and frame rate is much less important. For cardiology systems, frame rate is usually the most important CTQ, with the others much less important. Transmit focus is one of the most important determinants of spatial resolution. If only a single focal zone is used, then spatial resolution is